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JOURNAL

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Elisha Mitchell Scientific Society.

NORTH CAROLINA DESMIDS—A PRELIMINARY LIST.

W. L. POTEAT.

When one considers the acknowledged richness of the flora of North Carolina, it seems not a little strange that this peculiarly interesting family of plants should have been so completely neglected both by native and by visiting botanists. In the second volume of the Smithsonian Contributions to Knowledge may be found Professor J. W. Bailey's "Microscopical Observations made in South Carolina, Georgia, and Florida," published in 1851; but these notes contain no reference to North Carolina. With the poor exception of two or three species of *Vaucheria* reported from this State by v. Schweinitz, and a few other Algæ by Curtis (1860), the great group of Fresh-water Algæ as now known to the world contains no North Carolina representatives. And, if the view be restricted to the particular family that concerns us here, so far as I have been able to learn the record is a complete blank.

Moved partly by this consideration, for a few months past I have been engaged, as my limited leisure afforded opportunity, upon the determination of the species of Desmids found in the vicinity of Wake Forest, and some of the results of this work are presented below. The list is far from being exhaustive of

the material of this locality; nevertheless, it is offered in this imperfect form in the hope that it may prove to be of some value as a contribution to the Flora of North Carolina.*

The Desmidieæ are microscopic, unicellular plants of the order Conjugatæ. They are possessed of chlorophyll and absorb through their walls nourishment from the water in which they float or swim. They are confined to fresh water. The cell is usually constricted in the middle into two similar halves, and in general outline varies from cylindrical, crescent, and dumb-bell shape to the elliptic and circular, with margins smooth, or toothed, or lobed. The all but endless variety of their forms, combined with perfect symmetry of parts and exquisiteness of structure, makes the study of them a never-failing source of instruction and delight.

The following species in the vicinity of Wake Forest have been identified:

Hyalotheca disilliens, Brebisson.
Hyalotheca mucosa, Ralfs.
Desmidium Schwartzii, Agardh.
Desmidium Bayleyi, Wolle.
Desmidium aptogonium, Brebisson.
Sphærozosma spinulosum? Delponte.
Mesotænium Endlicherianum, Naegeli.
Spirotænia condensata, Brebisson.
Spirotænia obscura, Ralfs.
Penium digitus, Brebisson.
Penium interruptum, Brebisson.
Penium oblongum, De Bary.
Penium crassa, De Bary. 21 micros.
Penium lamellosum, Brebisson.
Penium margaritaceum, Brebisson.
Penium closterioides, Ralfs. 38 micros.

*In making the determination of species I have used the great works of Rev. Francis Wolle on the Desmids and on the Fresh-water Algæ of the United States. In case of difference of size (diameter) from that given by Wolle, I have stated the size in micro-millimetres.

Closterium moniliferum, Ehrenberg.
Closterium Leibleinii, Kuetzing.
Closterium areolatum, Wood.
Closterium lunula, Ehrenberg.
Closterium lineatum, Ehrenberg.
Closterium striolatum, Ehrenberg. Var. elongatum, Rabenhorst.
Closterium rostratum, Ehrenberg.
Closterium dianæ, Ehrenberg. (?)
Closterium gracile, Brebisson. 17 diameters long.
Closterium obtusum, Brebisson.
Closterium acutum, Brebisson.
Closterium acerosum, Ehrenberg.
Closterium nasatum, Nordstedt. (?) Not quite sure of the species, the sides of the suddenly contracted ends not being parallel, and the cell being 7 diameters long.
Docidium crenulatum, Rabenhorst.
Docidium trabecula, Naegeli.
Calocylindrus connatus, Kirchner.
Calocylindrus connatus. Var. minor, Nordstedt.
Calocylindrus minutus, Kirchner.
Calocylindrus Thwaitesii, Ralfs. (?) 21 micros.
Cosmarium ovale, Ralfs. (?) Margins almost destitute of granules; ends somewhat truncate.
Cosmarium punctulatum, Brebisson.
Cosmarium Pyramidatum, Brebisson.
Cosmarium cucumis, Corda. (?) 32 micros.
Cosmarium botrytis, Meneghini.
Cosmarium botrytis. Var. tumidum, Wolle.
Cosmarium undulatum, Corda. Var. crenulatum, Wolle. 32 micros.
Cosmarium notabile, Brebisson. 21 micros.
Cosmarium speciosum, Lundell. 32 micros.
Cosmarium portianum, Archer.
Cosmarium orbiculatum, Ralfs.
Cosmarium Schleiphackeanum, Grunow. 10 micros.
Cosmarium pseudobroomei, Wolle.

Cosmarium Braunii. Forma major, Reinsch. 21 micros.
Tetmemorus lævis, Ralfs. (?)
Xanthidium fasiculatum, Ralfs. Var. hexagonum, Wolle.
Euastrum verrucosum, Ralfs.
Euastrum verrucosum. Var. alatum, Wolle.
Euastrum verrucosum. Var. reductum, Nordstedt. (?)
Euastrum pinnatum, Ralfs.
Euastrum elegans, Kuetzing.
Euastrum binale, Ralfs.
Euastrum oblongum, Ralfs. 81 micros.
Euastrum ansatum, Ralfs. Var. major, Wolle.
Euastrum inerme, Lundell. Does not quite agree with Wolle's figure: the second crena on basal lobe is not so near end lobe.
Micrasterias Americana, Kuetzing.
Micrasterias laticeps, Nordstedt.
Micrasterias denticulata, Ralfs.
Micrasterias crenata, Ralfs.
Micrasterias decemdentata, Naegeli. 81 micros.
Micrasterias rotata, Ralfs.
Micrasterias conferta, Lundell.
Micrasterias furcata, Ralfs. (?) 105 micros.
Micrasterias Rabenhorstii, Kirchner. (?) 65 micros.
Micrasterias fimbriata, Ralfs. (?) Agrees with Wolle's text and figure, except that it is much too small.
Staurastrum orbiculare, Ralfs.
Staurastrum hirsutum, Ralfs.
Staurastrum echinatum, Brebisson.
Staurastrum spongiosum, Brebisson.
Staurastrum botrophilum, Wolle.
Staurastrum pygmæum, Brebisson. Forma genuina, Brebisson.
Staurastrum pygmæum. Forma truncata, Wolle.
Staurastrum pygmæum. Forma rhomboides, Wolle.
Staurastrum artiscon, Brebisson.
Staurastrum dilatatum, Ehrenberg. (?)
Staurastrum cyrtocerum, Brebisson.

Wake Forest College, May 2, 1888.

CONTRIBUTIONS FROM THE CHEMICAL LABORATORY UNIV. N. C.

No. XXXIX.

ON THE BROMINATION OF HEPTANE.

F. P. VENABLE.

Schorlemmer has shown that the heptane from *Pinus sabiniana* is probably identical with that from petroleum and is a normal heptane. With regard to the action of the halogens upon this heptane he says:* "By the action of chlorine upon a normal paraffin not all the chlorides indicated by theory are formed, but only the primary and a secondary chloride which contains the group $CHCl.CH_3$; by the action of bromine upon normal paraffins from petroleum only secondary bromides corresponding to chlorides are formed."

In my inaugural dissertation (Göttingen, 1881, p. 14) I stated that I found other products formed during the bromination of normal heptane besides the secondary bromide, but did not examine them more closely. It seemed to me worthy of note at the time that when the unfractionated residue boiling above 170° C. (the secondary bromide boils at 165°–167°) was allowed to stand some time and was then distilled, it yielded, under evolution of hydrogen bromide, a fair proportion of secondary bromide boiling at 165°–167°. Time and material have both been lacking to me since the period of that research, and hence I have made no closer examination of this point.

As it would be a strange and not very easily accounted for fact if bromine yielded only secondary products acting on normal paraffins, I determined to make use of a recent opportunity to examine this action more closely.

It may be stated that in several brominations of this heptane, made in recent years, I have found the yield of secondary bromide to be only about 25 or 30 per cent. of the theoretical,

*American Chemical Journal, **6**, 31.

much of the heptane remaining unattacked; and much having to be rejected as boiling too high. The amounts of heptane brominated at one time varied from 100 to 300 grams, and the bromine usually dropped in as fast as it could be absorbed by the hot heptane. No quantitative data were preserved of these experiments, however. The yield is seriously unsatisfactory with so expensive a material as the heptane.

The following experiments were quantitative and conducted with especial care:

I. 100 *grams of pure heptane and* 160 *grams of bromine.*— The heptane was kept boiling gently over a naked flame. The flask containing it was provided with an inverted condenser and a dropping funnel for the bromine. The bromine dropped in the liquid, keeping it orange-red in color. The operation required five hours. The heavy oil was then washed with dilute sodium carbonate, then with water, and finally dried over calcium chloride. It was yellow, with an orange tint. It was fractionated twice under a diminished pressure of 18-20 inches of mercury; then four times fractionated under ordinary pressure. The divisions were as follows:

Fraction I, 100°–120°, nearly all under 110°,	30 grams;
II, 120°–162°,	5
III, 162°–168°, mainly 164°–167°,	55
IV, 168°–173°,	2
V, 173°–183°, mainly between 176°–180°,	8
VI, 183°–210°	10

Probably one-fourth, in bulk, of the oil was left partly charred in the fractionating flasks.

II. 100 *grams of pure heptane and* 160 *grams of bromine.*— The same apparatus as above was used, only the dropping funnel was drawn out to a capillary and about half an inch of this was submerged under the heptane. The bromine entered thus slowly and in the form of vapor. The heptane was at first at a lower temperature than in the first experiment. The tempera-

ture had to be increased later on, but, so far as possible, all excess over that necessary for the absorption of the bromine was avoided. The time consumed by the reaction was about thirteen hours. The oil was then treated as above. It was redder in color. It was fractionated as above, only one time less under ordinary pressure.

Fraction I, 100°–120°, mainly under 110°, 35 grams;
II, 120°–162°, 5
III, 162°–168°, mainly 164°–167°, 25
IV, 168°–173°, 6
V, 173°–183°, mainly 176°–180° 20

No higher fraction than V was taken, though several grams could have been gotten by carrying the residue on to partial charring. Fraction V was in this case much more stable than the corresponding fraction in the first experiment. It did not turn brown so quickly, nor deposit black spots on the glass.

III. 50 *grams of pure heptane and* 80 *grams of bromine.*— No heat was used in this case. The heptane was in a small open Erlenmeyer flask which was set in a vessel of water. The bromine was poured in in small amounts and shaken until dissolved in the heptane, giving it a deep red color. Then it was allowed to stand in the light until only a yellow color remained. The temperature averaged about 6° C. The duration of the experiment was twenty-five days. The resulting oil was washed as above. It was bright yellow in color. It was fractionated once under diminished pressure and once under ordinary pressure. The following fractions were obtained:

Fraction I, 100°–120°, mainly under 110°, 12 grams;
II, 120°–162°, 2
III, 162°–173°, mainly 164°–167°, 4
IV, 173°–183°, 7
V, 183°–195°, very little;
VI, 195°–205°, 7 grams;
VII, 205°–215°, 12
VIII, 215°–230°, 8

These fractions above 195° were heavy, of a brownish yellow color, and not showing much decomposition on standing. This third method of bromination was tried several times with similar results. Analyses of two proportions of the fraction coming over about 210° gave 56.4 per cent. and 58.0 per cent. of bromine; $C_7H_{15}Br$ contains 44.69 and $C_7H_{14}Br_2$ 62.02 per cent. of bromine.

The results may be summed up thus: If we take into consideration the boiling points of the primary bromide (178.5°), secondary bromide, 164°–167°, and dibromide or heptylene bromide, 209°–211°, it will be seen that no mode of bromination tried yielded the secondary bromide alone. The first yields principally the secondary; the second yields secondary and primary, whereas the third yields mainly compounds having a high percentage of bromine, probably several isomeric bromides of heptylene. The action of bromine then seems to be quite similar to that of chlorine.

University of North Carolina February, 1888.

No. XL.

SOME NEW SALTS OF CAMPHORIC ACID.

G. W. EDWARDS.

This research is a continuation of the one in Volume IV, Part I, page 52. The following additional salts were prepared:

Aluminium Camphorate. Pure aluminium hydroxide was prepared, and this was then boiled with camphoric acid in excess, using only a little water. The resulting aluminium camphorate is white and quite insoluble. It was dried at 100° and analyzed.

	Caculated for $Al_2(C_{10}H_{14}O_4)_3$	Found. I.	II.
Al	8.33	8.16	8.24

Nickel Camphorate.—Pure nickel hydroxide was prepared and dissolved in camphoric acid, using as little water as possible. On heating this solution on the water-bath a crust, whitish-green in color, settled out. This was dried between bibulous paper and analyzed.

Analysis:

	Calculated for $Ni(C_{10}H_{15}O_4)_2$.	Found.
Ni	12.76	12.03

The liquid poured off from this crust stood some days over sulphuric acid. A further settling out of the crust mentioned above was noticed; then small green crystals began to form. The liquid was filtered away from the crust and once more placed in the desiccator. The crystals obtained were dried on bibulous paper and analyzed. It was impossible, however, to separate them from the crust. The analysis gave 12.50 per cent. of Ni. Hence the compound was the same as above.

Strontium Camphorate.—Strontium carbonate is but slightly attacked by camphoric acid in the cold. On heating with water the evolution of carbon dioxide is rapid. The resulting strontium camphorate is soluble in water. Clusters of crystals are easily gotten on evaporation over sulphuric acid. The first analysis of the crystals was lost. Analysis of a crystalline crust resulted as follows:

	Calculated for $SrC_{10}H_{14}O_4.6H_2O$.	Found.
Sr	22.23	21.50
H_2O	27.45	27.75

No. XLI.

NEW HALOGEN COMPOUNDS OF LEAD.

F. P. VENABLE AND B. THORP.

This research sprang from and is a continuation of the one upon Lead Chlorosulphocyanide in Volume IV, Part I, page 55.

Action of ammonium hydroxide upon lead chlorosulphocyanide.—Crystals of this salt, dried at 100° and kept several months, turn partially yellow from the formation of persulphocyanogen. Those merely dried in the air do not seem to undergo this change. Some of these air-dried crystals were covered with ordinary aqua ammonia in excess and allowed to stand for six days. The color of the crystals was slightly changed, becoming dirty yellowish-white. On analysis, after drying at 100°, they were found to contain 3.08 per cent. of chlorine. Sulphocyanic acid was also present, but was not determined. Another lot, after standing for three hours, gave 5.28 per cent. of chlorine. Crystals covered in the same way with ammonia water and boiled occasionally during six hours showed on analysis 2.76 per cent. of chlorine, and gave qualitative tests for sulphocyanic acid. Others boiled in this way during three or four weeks gave but a bare opalescence with silver nitrate. Ammonium hydroxide, then, does not remove either of the radicals combined with the lead in preference to the other, but removes both at the same time, until only lead hydroxide is left. Nor do there seem to be any distinct steps of removal or regular basic compounds formed as in the case of the action of ammonium hydroxide on lead chloride and iodide.*

Lead bromosulphocyanide.—Lead bromide crystallized from a strong solution of potassium sulphocyanide gave slightly brown-

*Chemical News, **52**, 43.

ish crystals, apparently of the first system. These were dried on filter paper and then over sulphuric acid. They contained 23.05 per cent. of bromine and 16.65 per cent. CNS. Calculated for PbBrCNS, 23.02 per cent. bromine and 16.85 per cent. CNS.

Hydrobromic acid was added to the mother-liquor of these crystals, and on evaporation a crop of clumpy, indistinctly yellowish crystals was obtained. These were dried and analyzed, giving 3.46 per cent. of CNS. Calculated 3.56 per cent. of CNS for $8PbBr_2.Pb(CNS)_2$.

Lead iodosulphocyanide.—The first attempt at preparing this salt was by adding the excess of potassium sulphocyanide, in solution, to freshly precipitated lead iodide. On washing with hot water lead iodide alone crystallized out. Again sulphocyanic acid was used to dissolve lead iodide, but the double compound refused to form and again the iodide only crytallized out. When equivalent amounts of lead iodide and lead chlorosulphocyanide were dissolved in boiling water and allowed to crystallize, the iodide crystallized out by itself. Lastly, lead iodide was dissolved in a strong solution of potassium sulphocyanide. This gave on cooling small glistening nearly white crystals. It is interesting to note in this and other cases where double compounds with lead iodide were obtained, that at one stage of the cooling numbers of large, distinct crystals of lead iodide would separate. On further standing and cooling these would entirely disappear and all the crytals would be of the double compound.

Analysis gave for this compound figures corresponding to 57.22 per cent. Pb. Calculated for $PbI_2.3Pb(CNS)_2$, 57.83 per cent. Pb.

Lead chlorocyanide.—When lead chloride crystals were covered with a strong solution of potassium cyanide, a heavy and quite insoluble body was formed which, on standing, rapidly changed in color to a purplish brown. This was due to partial decomposition and loss of hydrocyanic acid.* This heavy in-

*Chemical News, **51**, 45.

soluble powder was washed and then dried at 100°. The analyses gave the following results, the CN being found by difference:

	Calculated for $2Pb(CN)_2.PbCl_2$.	Found.	
Pb	77.98	78.46	78.32
Cl	8.76	8.29	8.47
CN	13.22	13.25	13.21

Lead ferrocyanide could not be induced to crystallize with lead chloride. It is so insoluble that few of the methods of formation used in this research could be put into practice. On covering lead chloride with a solution of potassium ferrocyanide, the lead gave up its chlorine completely. The resulting lead ferrocyanide persistently retained some potassium ferrocyanide. Again, when lead ferrocyanide was boiled for some time with potassium chloride, neither filtrate nor residue contained the desired double salt.

Lead ferrocyanide covered with ammonia water for several weeks yields a brownish-gray white mass which was free of ammonia and contained 12.42 per cent. of ferrocyanic acid and .45 per cent. of ferric oxide. It is a basic ferrocyanide.

Of course the attempt to crystallize lead ferrocyanide from hydrochloric acid ended in the decomposition of the ferrocyanide with the formation of lead chloride and separation of Prussian blue.

Lead bromiodide. When lead iodide is dissolved in hydrobromic acid, the first crystals are of a deep yellow tint, approaching orange. The crystals on analysis yielded 49.75 per cent. Pb. Calculated for $PbBr_2.PbI_2$, Pb=49.93 per cent. These crystals then have the composition represented by the formula $PbBr_2.PbI_2$.

The second crop of crystals have a straw-yellow color and gave 52.99 and 52.57 per cent. Pb, 30.61 per cent. Br, and 16.20 per cent. I. Calculated for $3PbBr_2.PbI_2$, 52.94 per cent. Pb, 30.77 per cent. Br, and 16.32 per cent. I.

The third crop are white in color and yield on analysis 54.19 and 54.34 per cent. Pb. The calculated percentages for a substance of the composition $6PbBr_2.PbI_2$ are=54.34 per cent. Pb.

The fourth crop are also white, and gave only a slight reaction for iodine. They contained 56.12 per cent. Pb, and are therefore nearly pure lead bromide. In form these crystals are all alike, closely resembling ordinary lead bromide.

Lead chlorobromiodide.—Lead chloride, lead bromide and lead iodide were dissolved together in hot water and allowed to crystallize. No special proportions were taken, though in the first experiment an excess of lead iodide was probably present. In the second, more lead bromide and lead chloride were present, with the bromide probably in excess. In both cases the iodide crystallized out abundantly, immediately on cooling. The second, third and fourth crops of crystals were taken separately. They were like one another in appearance, forming masses of long silky yellowish white needles. They combined chlorine, bromine, and iodine. Analyses of the three last fractions in the second experiment gave the following percentages of lead:

I. Pb=60.34; II. Pb=61.48; III. Pb=61.32. Analysis of the fourth fraction gave, IV. Pb=61.57.

There seems to be only one compound formed, as in I. the analysis was probably defective.

From these experiments it is evident that lead has quite a facility for forming double compounds with the halogens and analogous radicals, forming probably in many cases a series of such salts with various ratios between the halogens, all being quite stable and crystallizing nicely.

ON THE CHORD COMMON TO A PARABOLA AND THE CIRCLE OF CURVATURE AT ANY POINT.*

R. H. GRAVES.

It is known that if a circle meet a parabola in four points the sum of the distances of the points on one side of the axis from it is equal to the sum of the distances of the points on the other side from it. If three of the points are coincident, the circle becomes the circle of curvature, and the distance of the three coincident points (P) from the axis is one-third of that of the fourth point from the axis.

Hence the common chord of the circle and parabola is divided by the axis in the ratio 1:3. But the shorter segment of the chord is equal to the tangent at P, since they are equally inclined to the axis. Therefore the chord is equal to four times the tangent. Let $y^2=4ax$ be the equation to the parabala, and (x', y') the co-ordinates of P. Then

$$y-y'=-\frac{2a}{y'}(x-x'), \text{ or } yy'+2ax-\tfrac{3}{2}y'^2=0,$$

is the equation to the chord.

Differentiating with respect to y', $y=3y'$; hence $y^2=-12ax$ is the envelope of the chord. Also, from the relation $y=3y'$, it follows that the longer segment of the chord is equal to the corresponding tangent of the parabola $y^2=-12ax$.

The point P, and the point where the chord prolonged touches $y^2=-12ax$, are harmonic conjugates with respect to the points where it meets the axis and the tangent at the common vertex of the parabolas.

The tangent at the end of the *latus rectum* of $y^2=-12ax$ is normal to $y^2=4ax$ at the end of its *latus rectum*, and therefore touches its evolute. The chord is then a diameter of the circle of curvature, and is bisected by its point of contact with the evolute.

Hence the radius of curvature=twice the normal=$4a\sqrt{2}$, which agrees with a known result.

*This article and the following one have appeared in the "Annals of Mathematics."

ON THE FOCAL CHORD OF A PARABOLA.*

R. H. GRAVES.

Let $y^2=4ax$ be the equation to a parabola, S its focus, and PSP′ a focal chord. Let the tangent and normal at P′ meet the diameter through P at M and N.

It may be easily proved that PM=PN=PP′ and that a similar property holds for the tangent and normal at P.

Therefore, if two equal rhombs be constructed on PP′ having two other sides of each parallel to the axis, their diagonals are tangents and normals at P and P′; and the tangent at one point is parallel to the normal at the other.

Each normal chord divides the other in the ratio 1:3.

The chord joining the other ends of the normal chords is parallel to PP′ and three times as long.

A line perpendicular to PP′ at S, and terminated by this parallel chord and the pole of PP′, is divided by S in the ratio 1:4.

Hence the locus of the foot of the perpendicular dropped from S on the parallel chord is a right line, whose equation is $x=9a$.

Hence the envelope of the parallel chord is a confocal parabola, having for its equation $y^2=32a(9a-x)$.

It cuts the original parabola orthogonally where it is cut by its evolute.

*This article has been translated and appeared in the Jornal de Sciencias Mathematicas e Astronomicas, published at Coimbra.

CONTRIBUTIONS FROM THE BIOLOGICAL LABORATORY OF THE UNIV. OF N. C.

No. X.

LIST OF FISHES IN THE MUSEUM OF THE UNIVERSITY OF NORTH CAROLINA, WITH DESCRIPTION OF A NEW SPECIES.

V. S. BRYANT.

Family SPHYRNIDÆ.

1. *Reniceps tiburo* (L.) Gill. Shovel-head Shark; Bonnet Head.

Family LEPIDOSTEIDÆ.

2. *Lepidosteus osseus* (L.) Agassiz. Long-nosed Gar; Billfish; Common Gar Pike.

Family SILURIDÆ.

3. *Amiurus platycephalus* (Grd.) Gill.
4. *Amiurus erebennus* (Holbrook) Jordan.
5. *Amiurus vulgaris* (Thompson) Nelson.
6. *Ictalurus albidus* (Le Seur) J. and G. White. Cat; Channel Cat of the Potomac.

Family CYPRINIDÆ.

7. *Minnilus diplaemius* (Raf.) Hay. Red-fin.

Family CLUPEIDÆ.

8. *Clupea mediocris* Mitchill. Hickory Shad; Tailor Herring; Fall Herring.
9. *Clupea æstivalis* Mitchill. Glut Herring; Blue Back.
10. *Clupea sapidissima* Wilson. Common Shad.

Family SALMONIDÆ.

11. *Salvelinus fontinalis* (Mitch.) Gill and Jor. Brook Trout; Speckled Trout.

Family ANGUILIDÆ.

12. *Anguilla rostrata* (Le Seur) De Kay. Common Eel.

Family SCOMBERESOCIDÆ.

13. *Tylosurus longirostris* (Mitch.) J. and G. Gar-fish; Bill-fish; Needle-fish.

Family MUGILIDÆ.

14. *Mugil albula* L. Striped Mullet.

Family CARANGIDÆ.

15. *Caranx hippus* (L.) Gunther. Crevallé; Horse Crevallé.

16. *Selene vomer* (L.) Lutken. Moon-fish; Look Down; Horse-head.

Family POMATOMIDÆ.

17. *Pomatomus saltator* (L.) Gill. Blue-fish; Green-fish; Skip-jack.

Family CENTRARCHIDÆ.

18. *Promoxys annularis* Raf. Crappie; Batchelor; New Light; Campbellite..

19. *Promoxys sparoides* (Lac.) Grd. Calico Bass; Grass Bass; Barfish; Strawberry Bass.

20. *Chaenobryttus gulosus* (C. and V.) Jor. War Mouth. Red-eyed Bream.

21. *Lepomis gibbosus* (L.) McKay. Common Sun-fish; Bream; Pumpkin Seed; Sunny.

22. *Micropterus salmoides* (Lac.) Henshall. Large-mouthed Black Bass; Oswego Bass; Green Bass; Bayou Bass.

Family PERCIDÆ.

23. *Perca americana* Schranck. Yellow Perch; American Perch; Ringed Perch.

24. *Stigrostedium vitreum* (Mitch.) Jor. and Copeland. Wall-eyed Pike; Dory; Glass-eye; Yellow Pike; Blue Pike; Jack Salmon.

Family SERRANIDÆ.

25. *Roccus lineatus* (Block) Gill. Striped Bass; Rock-fish; Rock.

26. *Roccus americanus* J. and G. White Perch.

27. *Serranus atrarius* (L.) J. and G. Black-fish; Black Sea Bass.

Family SPARIDÆ.

28. *Pomadasys fulvomaculatus* (Mitch.) J. and G. Sailor's Choice; Hog-fish.

29. *Diplodus rhomboides* (L.) J. and G. Pin-fish; Bream.

30. *Diplodus probatocephalus* (Walb.) J. and G. Sheepshead.

Family SCIANIDÆ.

31. *Pogonias chromis* (Linn.) C. and V. Drum.

32. *Sciæna ocellata* (L.) Gthr. Channel Bass; Red Horse; Red Bass.

33. *Liostomus xanthurus* Lac. Spot; Goody; Oldwife; La Fayette.

34. *Cynoscion maculatum* (Mitch.) Gill. Spotted Sea Trout.

Family LABRIDÆ.

35. *Tautoga onitis* (L.) Gthr. Tautog; Black-fish; Oyster-fish.

Family TRIGLIDÆ.

36. *Prionotus tribulus* Cuv. and Val.

37. *Prionotus evolans* Linn.

Family BATRACHIDÆ.

38. *Batrachus tau* (Linn.) Cuv. and Val. Toad-fish; Oyster-fish; Sarpo.

Family PLEURONECTIDÆ.

39. *Paralichthys dentatus* (L.) J. and G. Common Flounder.

Family TETRODONTIDÆ.

40. *Chilomycterus pentodon* N. Sp. One specimen taken in Beaufort in 1882. The character of the spines noted below was first discovered by Mr. V. S. Bryant.*

Family DOROSOMATIDÆ.

41. *Dorosoma cepedianum* (L. S.) Gill. Gizzard Shad; Hickory Shad.

**Chilomycterus pentodon* N. Sp. The prominent character of this species is the possession of four roots by some of the dorsal spines. There are seven of these spines in this specimen, arranged as follows: Four in a transverse row, forming the second row caudal of the eyes; two in a transverse row behind these, set a little to the right of the two middle ones of the first row; two in a median dorsal row behind them; and one in the centre of the face in line with the anterior edge of the eyes. Color and markings much as in *Chilomycterus schœpfi* (*geometricus*), but in addition to the black spots, above and behind pectorals, and at base of dorsal, is a spot on each side a little in front of the caudal peduncle. One specimen taken at Beaufort in 1882. The character of the spines differing from other species of this genus was first discovered by Mr. V. S. Bryant. GEO. F. ATKINSON.

No. XI.

LIST OF THE BUTTERFLIES COLLECTED AT CHAPEL HILL, N. C.

A. BRASWELL.

Family PAPILIONIDÆ.

1. *Papilio ajax* Linn. Form *walshii Edw.*
2. *Papilio ajax.* Form *telamonides* Feld.
3. *Papilio philenor* Linn.
4. *Papilio asterias* Fab.
5. *Papilio troilus* Linn.
6. *Papilio palamedes* Drury.
7. *Papilio turnus* Linn.
8. *Papilio turnus glauca* Linn.
9. *Pieris rapæ* Linn.
10. *Anthocaris genutia* Fab.
11. *Anthocaris olympia* (?) Edw.
12. *Callydrias eubale* Linn. Seen, not taken.
13. *Colias eurytheme* Bd.
14. *Colias philodice* Godt.
15. *Terias nicippe* Cram.
16. *Terias lisa* Bd–Lec.
17. *Terias delia* Cram.
18. *Terias jucunda* Bd–Lec.

Family NYMPHALIDÆ.

19. *Danais archippus* Fab.
20. *Argymis diana* Cram. Balsam, N. C.
21. *Argymis cybele* Fab.
22. *Argymis aphrodite* Fab. Balsam, N. C.
23. *Euploieta claudia* Cram.
24. *Phyciodes thoros* Drury. Summer form *morpheus*, var. A—1, and var. A—2. Winter form *marcia*, var. B—5, var.

D—11, var. D—12, and var. D—13. Determined by Prof. G. H. French, Carbondale, Ill.

25. *Grapta interrogationis* Fab. *Fabricii* Edw.
26. *Grapta interrogationis umbrosa* Lintn.
27. *Grapta comma* Harris, *harrisii*, Edw.
28. *Grapta comma dryas* Edw.
29. *Vanessa antiopa* Linn.
30. *Pyrameis atalanta* Linn.
31. *Pyrameis huntera* Fab.
32. *Pyrameis cardui* Linn.
33. *Junonia coenia* Hüb.
34. *Limenitis ursula* Fab.
35. *Limenitis disippus* Godt.
36. *Neonympha gemma* Hüb.
37. *Neonympha eurytris* Fab.
38. *Satyrus alope* Fab.
39. *Satyrus pegale* Fab.
40. *Libythea bachmanni* Kirtl.
41. *Theda halesus* Cram.
42. *Theda m. album* Bd–Lec.
43. *Theda calanus* Hüb.
44. *Theda smilacis* Bd–Lec.
45. *Theda humuli* Harr.
46. *Theda poeas* Hüb.
47. *Theda niphon* Hüb.
48. *Chrysophanus hypophleas* Bd.
49. *Lycæna pseudargiolus* Bd–Lec.
50. *Lycæna comyntas* Godt.

Family HESPERIDÆ.

51. *Ancyloxypha numiter* Fab.
52. *Pamphila metea* Scud.
53. *Pamphila huron* Edw.
54. *Pamphila otho* Sm–Abb.
55. *Pamphila accius* Sm–Abb.
56. *Pamphila maculata* Edw.

57. *Pamphila peckius* Kirby.
58. *Amblycertes eos.* Edw.
59. *Amblycertes vialis* Edw.
60. *Pyrgus tessellata* Scud.
61. *Nisioniades juvenalis* Fab.
62. *Nisioniades brizo* Bd–Lec.
63. *Nisioniades icelus* Lintn.
64. *Nisioniades martialis* Scud.
65. *Pholisora catullus* Fab.
66. *Eudamus pylades* Scud.
67. *Eudamus bathyllus* Sm–Abb.
68. *Eudamus tityrus* Fab.
69. *Eudamus lycidas* Sm–Abb.

No. XII.

AQUATIC RESPIRATION IN THE MUSK-RAT.

W. L. SPOON.

During the winter of 1879–'80 I spent much of my time trapping the musk-rat, and had rare opportunities for studying their habits. I have frequently noticed an ingenious device, to serve as an apparatus for aquatic respiration, resorted to by the animal when driven from its burrow into a pond frozen over. In attempting to cross the pond under the ice, if the pond is too wide for the musk-rat to "hold its breath" until it reaches the opposite shore, it will stop for a few moments, exhale the air, which is held down by the ice. Interchange of gases takes place between the air and water, when the animal re-breathes the air and makes another start, repeating the act until the shore is reached.

I do not claim this as an original observation. Others than myself have noticed it. It is well known by those who have

observed the phenomenon that if the ice is struck immediately above the air, and the air thus scattered into numerous bubbles, the musk-rat drowns. Having noticed an account by Professor Comstock* of the use, by the "water boatman," of a bubble of air for a tracheal gill, I would call attention to this interesting feature in the physiology of respiration of the musk-rat.

CHANGES IN BOTTLED SAMPLES OF ACID PHOSPHATE WITH CONSTANT PERCENTAGE OF WATER, AND ORDINARY TEMPERATURE.

WILLIAM B. PHILLIPS.

Several years ago, when Chemist to the Navassa Guano Co., Wilmington, N. C., it occurred to me to determine the changes taking place in a sample of acid phosphate drawn directly from the mixer, bottled and cooled, and examined every week for twelve consecutive weeks. The results have been on hand since that time, as it was hoped to supplement them by others of the same kind. The opportunity of adding to them does not present itself, and as they may prove of interest they are given as obtained then.

The rock used was Charleston rock of the following composition:

	PER CENT.
Moisture @ 100° C.,	6.52
Loss at red heat,	3.83
Insoluble Silica,	17.84
Soluble Silica,	0.10
Carbonic Acid,	2.80
Phosphoric Acid,	22.82
Lime,	33.60
Oxide of Iron,	11.56
	99.07

All of it passed a 60° seive.

*American Naturalist, June, 1887.

The charge was:

Rock, ...	1,200 lbs.
Sulphuric Acid 47° B, . . .	1,050 "

The temperature of the acid was 60° C. (140° F.), the temperature in the mixer 82° C. (180° F.). The mixture was stirred vigorously for three minutes, sampled, and dumped. The sample was put into a tightly-corked bottle, cooled at once, and analyzed. The analytical method throughout was that of the Association of Official Chemists for 1884. For the determination of free phosphoric acid the following method was employed: Two grams (2 grms.) substance were extracted with 200 c. c. 80° alcohol, and the phosphoric acid estimated in the filtrate. The calculation was:

$\times$=free P^2O^5.
Y=P^2O^5 as $CaH^4P^2O^8$.
P=P^2O^5 extracted by water.
Q=P^2O^5 extracted by 80° alcohol.

Then

$$P=\times+Y.$$
$$Q=\times+\tfrac{1}{2}Y.$$
$$\times=2Q-P.$$
$$Y=2(P-Q).$$

After finding, by several careful determinations, that the dry-basis total P^2O^5 was 15.84 per cent., for convenience of comparison the following table was constructed:

TABLE No. I.

When analysis was made.	Analysis No.	Each Analysis on Water-free Basis. Total P_2O_5 for each = 15.84 per cent.								Calculated Analysis.	
		Phos. Acid Sol. in Water.	Phos. Acid Insol. in Water.	Phos. Acid Sol. in Am. Cit. 65° "Reverted."	Phos. Acid Insol. in Am. Cit. 65° C.	Free Phos. Acid.	Phos. Acid as Monocalcic Phosphate $CaH_4P_2O_8$.	Water @ 100° C.	Avail. Phos. Acid Sol. and Rev'd.		
		Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.		Pr. ct.
At mixing.	406	11.81	4.04	1.58	2.45	1.81	10.00	27.75	13.39	P_2O_5 Tot.	16.00
End of 1st week.	411	13.34	2.50	1.58	0.92	5.90	7.43	27.65	14.92	" Sol.	12.29
" 2d "	414	13.45	2.39	1.72	0.67	4.68	8.77	27.73	15.17	" In-sol. in Water	3.71
" 3d "	420	13.45	2.39	1.27	1.12	6.24	7.20	27.80	14.72		
" 4th "	424	13.44	2.40	1.79	0.61	6.16	7.28	27.78	15.23	Water	24.51
" 5th "	433	13.09	2.75	1.21	0.54	4.31	8.78	27.80	14.30		
" 6th "	435	12.89	2.95	2.66	0.29	6.17	6.72	27.70	15.55		
" 7th "	441	12.42	3.42	2.90	0.52	6.33	6.08	27.70	15.32		
" 8th "	445	12.27	3.57	3.19	0.38	5.24	7.03	27.70	15.46		
" 9th "	450	13.62	2.22	1.78	0.44	4.77	8.85	27.70	15.40		
" 10th "	455	12.83	3.01	3.01	0.00	5.56	7.41	27.70	15.84		
" 11th "	457	12.92	2.92	2.09	0.32	5.89	7.03	27.70	15.52		
" 12th "	463	13.08	2.76	2.44	0.32	6.22	6.86	27.70	15.52		

Another table was constructed, taking the dry-basis total phosphoric acid as 100 from each analysis.

TABLE No. II.

THE DRY-BASIS TOTAL PHOS. ACID IN EACH ANALYSIS IS 100.

Time of making Analysis.	Analysis No.	Phos. Acid Sol. in Water.	Phos. Acid Insol. in Water.	Phos. Acid Sol. in Am. Cit. 65° C. "Reverted."	Phos. Acid Insol. in Am. Cit. 65° C. "Insoluble."	Free Phos. Acid.	Phos. Acid as Monocalcic Phosphate $CaH_4P_2O_8$.
At mixing.	Calculated.	76.80	23.20				
"	406	74.62	25.38	9.98	15.40	11.43	63.19
End of 1st week.	411	84.74	15.26	9.98	5.28	37.31	47.43
" 2d "	414	84.74	15.26	10.85	4.41	29.59	55.15
" 3d "	420	84.74	15.26	8.02	7.24	39.52	45.22
" 4th "	424	84.74	15.27	11.30	3.97	38.91	45.82
" 5th "	433	82.64	17.36	7.63	9.56	27.25	55.56
" 6th "	435	81.30	18.70	16.81	1.89	39.06	42.24
" 7th "	441	78.74	21.26	18.31	2.95	40.00	38.74
" 8th "	445	77.52	22.48	20.16	2.32	33.11	44.44
" 9th "	450	86.21	13.79	11.23	2.56	30.12	56.09
" 10th "	455	81.30	18.70	18.70	0.00	35.09	46.21
" 11th "	457	81.56	18.44	16.42	2.02	26.89	54.67
" 12th "	463	82.64	17.36	15.38	1.98	39.21	43.43

A third table was constructed showing the phosphoric acid extracted by 80 per cent. alcohol, and the percentage of insoluble phosphoric acid in the residue from alcohol. The total dry-basis phosphoric acid is taken as 100 from each analysis.

TABLE No. III.

THE DRY-BASIS TOTAL P_2O_5 IN EACH ANALYSIS IS 100.

Time of Making Analysis.	No. of Analysis in Book.	P_2O_5 Sol. in 80 per cent. Alcohol.	P_2O_5 Insol. in 80 per cent. Alcohol.	P_2O_5 Insol. 65° from 80 per cent. Alcohol.	P_2O_5 Reverted from 80 per cent. Alcohol.
At mixing.	406	42.95	57.05	34.06	22.99
End of 1st week.	411	61.38	38.62	9.08	29.54
" 2d "	414	60.13	39.87	7.62	32.25
" 3d "	420	65.61	34.39	6.93	27.46
" 4th "	424	63.13	36.87	6.11	30.76
" 5th "	433	58.21	41.79	5.09	36.70
" 6th "	435	64.47	35.53	4.06	31.47
" 7th "	441	65.10	34.90	4.71	30.19
" 8th "	445	59.10	40.90	3.51	37.39
" 9th "	450	59.84	40.16	2.53	37.63
" 10th "	455	59.84	40.16	3.51	36.65
" 11th "	457	63.11	36.89	3.22	33.67
" 12th "	463	64.43	35.57	2.59	32.98

What can be deduced from these results? Let us first consider the soluble phosphoric acid, as exhibited in Table No. I, with a constant amount of total phosphoric acid. Starting at 11.81 per cent. at mixing it rises to 13.34 (a gain of 1.57 per cent.) in one week. The highest gain is at the end of the ninth week—1.81 per cent.—so that we may say that under the conditions of the experiment there is but little change in the soluble phosphoric acid after the first week. These conditions were exclusion of air, constant moisture and ordinary temperature.

PHOSPHORIC ACID INSOLUBLE IN WATER.

At mixing 4.04 per cent., at end of first week 2.50 per cent., a loss of 1.54 per cent. The greatest loss was at the end of the ninth week—1.82 per cent., corresponding to the gain in soluble phosphoric acid.

REVERTED PHOSPHORIC ACID.

At mixing 1.58 per cent., at end of first week 1.58 per cent. The greatest difference was at the end of the fifth week, when it had fallen to 1.21 per cent., a loss of 0.37 per cent. At the end of the ninth week there was a gain of 0.20 per cent.

"INSOLUBLE" PHOSPHORIC ACID.

At mixing 2.45 per cent., at end of first week 0.92 per cent., and at end of tenth week there was none.

It is unnecessary to proceed further in this way; the figures stand for themselves.

The chief point of interest is that the changes taking place in acid phosphates, whereby more or less insoluble reverted phosphates are produced, are due mainly to the high temperature in the heaps. This temperature may at times be as high as 240° F., and appears to induce the formation of iron-calcium phosphates, or, if aluminum be present, of iron-aluminum-calcium phosphates. If some method could be devised by which a rapid cooling of the freshly made acid phosphate could be attained, we would hear less of reversion. This is more particularly the case when mineral phosphates containing considerable quantities of iron and aluminum are used for the manufacture of acid phosphates.

With the present condition of the fertilizer trade, however, the product must be made in large quantities and stored in warehouses, where it often reaches a higher temperature than in the mixer. In the warehouse the stuff dries itself, becomes light and porous, and is easily disintegrated, which is not the case if it be rapidly cooled as it comes from the mixer. On the whole,

it is far better, both for the manufacturer and the consumer, to secure a product easily pulverized, with a moderate amount of insoluble phosphate remaining, than one in lumps, sticky and unmanageable, though nearly all soluble in water. Reversion takes place very quickly in the soil any way, and diffusibility is of prime importance.

CONTRIBUTIONS FROM THE BIOLOGICAL LABORATORY OF THE UNIV. OF N. C.
No. XIII.

NEW INSTANCES OF PROTECTIVE RESEMBLANCE IN SPIDERS.

GEO. F. ATKINSON.

Within the past two years two interesting cases of protective resemblance have come under my observation. A small species, *Thomisus aleatorius* Hentz, is remarkable for having the two anterior pairs of legs very long, while the two posterior pairs are very slender and short. The spider is very common on grass. One summer day, while reclining in the shade, I watched an individual of this species as it passed from one culm to another. Soon it ran up the stem a short distance and suddenly disappeared from view. For some time I was greatly puzzled as to the manner of its disappearance. Upon close scrutiny, I saw the spider clinging with its posterior legs to the stem. Its two anterior legs on each side were approximated and extended outward, forming an angle with the stem, strikingly similar to the angle formed by the spikelets.

An undescribed species of *Cyrtarachne* mimics a snail shell, the inhabitant of which during the summer and fall is very abundant on the leaves of plants in this place. In the species of *Cyrtarachne* the abdomen partly covers the cephalothorax, is very broad at the base, in this species broader than the length of the spider, and rounds off at the apex. When it rests upon the underside of a leaf with its legs retracted it strongly resem-

bles one of these snail shells by the color and shape of its abdomen. The two specimens which I collected deceived me at first, but a few threads of silk led me to make an examination. The spider seemed so confident of its protection that it would not move when I jarred the plant, striking it several hard blows. I pulled the spider forcibly from the leaf, and it did not exhibit any signs of movement until transferred to the cyanide bottle. The cocoons which I have found here are also protected by mimicry. They are essentially like those of *Cyrtarachne bisaccata* Emert.* They are dark brown, about 12^{mm} in diameter, and are provided on two opposite sides with stems made of the same colored silk, about 5^{mm} in diameter. The whole structure, which is hung in the branches of some weed, strongly resembles an insect gall made on the stem of some plant. As the species seems to be new, I append a description.

Cyrtarachne multilineata, N. Sp. Middle eyes on a slight elevation, forming a trapezium, the posterior a little larger and farther apart than the anterior. Side eyes at a distance, very close to each other, also on a slight elevation. Ceph'x brownish, rising gradually from the low head to the abdomen, which partly covers it, not narrowed behind the eyes, convex on the sides, covered with minute tubercles, the two dorsal elongated prominences ending each in two blunt points. Abdomen triangular, sides slightly convex, angles rounded, ventral surface deeply concave. Anterior one-third of abdomen hair brown mottled with the ground color—ecru drab—a pair of large spots of the ground color near the posterior edge of the brown. On the posterior part of the abdomen are several transverse bars of hair brown, becoming successively narrower and shorter toward the apex. Four of the muscular impressions very deep. Sides and posterior part of the abdomen marked with numerous hair brown depressed lines, starting from near the ventral surface, and passing up over the dorsal surface of the edge, four of those on the posterior part passing up nearly to the posterior pair of deep muscular impressions. On the ventral surface there is a rect-

*Trans. Conn. Acad. Sci., Vol. VI, 1884, p. 325.

angular spot extending from the spinnerets to the anterior edge, the anterior half of this brown, the posterior white; the depressed lines arise from the sides of this spot. Legs light-colored. Described from two females. Length of the larger 13^{mm}, abdomen 15^{mm} broad, 10^{mm} long; length of the smaller 11^{mm}, abdomen 13^{mm} broad, 9^{mm} long.

No. XIV.

NOTE ON THE TUBE-INHABITING SPIDER, LYCOSA FATIFERA HENTZ.

G. F. ATKINSON.

There seems to be a general impression that the tube-building *Lycosidæ* do not use their holes for such a permanent abiding place as do the trap-door spiders. Good authorities hold that a majority, and perhaps all, use the tube only as a winter resort, or for a retreat in the summer during the time of moulting, though the testimony on this point is by no means universal. There seems good reason, however, for believing that nearly all desert their tubes during the spring and summer at times, and wander in search of their prey. Indeed, there are indications that there are latitudinal as well as seasonal variations in the habits of the family, *i. e.*, that in northern latitudes proportionately a greater number make no tubes than in southern latitudes. The latitudinal variation might be called *genetic*, in that many species of the genus in northern latitudes hide away under stones, etc., making no tubes at all; while in southern latitudes many other species of the same genus construct tubes, some few using them habitually, many others temporarily. On the other hand, seasonal variations might be called *specific*, in that most species in any latitude which construct tubes use them only during inclement seasons or during periods of weakness. One species I have observed here, *Lycosa fatifera* Hentz, habitually uses its tube at all seasons, never, or very rarely, wandering in search of prey. I have many times watched them resting at the open-

ing of the tube, waiting for passing insects. They will dart back into their tubes when alarmed. Hentz reported this species from Massachusetts and Alabama. I have made special investigations upon the species in North Carolina, with a view to establish, if possible, the identity of Hentz's species *fatifera*, and the correctness of his statement that it uses the tube habitually at all seasons. The species can be easily recognized from Hentz's description. The one I find here is the *piceous* variety, which Hentz reported from Alabama, and not the typical form from Massachusetts.

TEMPERATURE AND RAIN-FALL AT VARIOUS STATIONS IN NORTH CAROLINA.

J. A. HOLMES.

The accompanying tables of temperature and precipitation at stations in North Carolina include the results of all observations accessible, collected from different sources. As a basis for the whole, I have made use of the MS. records of the Geological Survey of North Carolina, from observations made under the direction of the late Professor W. C. Kerr (stations marked "a" in the tables). A few records (b) have been taken from Kerr's Report on the Geology of North Carolina, 1875 (pp. 71 and 83); a considerable number have been taken from the Smithsonian Temperature Tables, 1876, and the Smithsonian MS. records (c), and from the published reports or MS. records of the United States Signal Service (d). A few records (e) have been furnished by the North Carolina Agricultural Experiment Station at Raleigh.

Except where otherwise noted the observations have been taken daily at 7 A. M., 2 P. M., and 9 P. M. The daily mean has generally been obtained by dividing the sum of the 7 A. M., 2 P. M., and twice the 9 P. M. (local time) observations by 4; the monthly, by dividing the sum of the daily by the number of days in the month. Temperatures for the region are averages of stations in each region.

Monthly, Seasonal, and Annual Mean Temperature (in Degrees Commencement

[Records of stations are to be credited to the following sources, as indicated in each logical Survey; **b** Kerr's Geology of N. C., 1875; **c** Smithsonian Temperature Tables, **e** MS. records of the N. C.

Station.	Lat.	Long.	Height.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Annual.	
Albemarle—b	35°18′	80°11′	650	39	42	47	58	64	75	79	77	70	57	46	39	56	77	57	40	58	1
Asheville—a and c	35°36′	82°28′	2250	38	40	46	54	62	69	73	71	64	53	43	37	54	71	53	38	54	2
(1) Attaway Hill—a	35°25′	80°00′	850	38	40	47	57	64	74	78	76	69	56	45	38	56	76	57	39	57	3
Bakersville—a	36° 3′	82° 6′	2550	36	39	38	51	60	66	72	74	65	54	46	39	50	71	55	38	53	4
Banner's Elk—a	36°10′	81°52′	.....	32	33	34	44	48	62	66	...	...	...	...	...	38	42	...	...	34	...	5
Beaufort—a	34°42′	76°40′	12	45	44	49	60	69	77	80	79	75	64	56	48	59	78	65	45	62	6
Boone—a and b	36°14′	81°39′	3250	33	33	37	48	57	65	69	64	62	48	34	30	47	66	48	32	48	7
Brevard—d	35°14′	82°46′	2200	37	41	46	53	65	68	...	70	68	60	43	43	55	...	57	40	...	8
(2) Carthage—a	35°23′	79°26′	.....	39	46	50	59	68	76	79	78	72	63	47	40	59	78	61	42	60	9
Cashier's Valley—a	35° 4′	83° 5′	3812	38	42	46	52	55	64	64	64	60	54	40	34	51	64	51	38	51	10
Chapel Hill—a and c	35°54′	79°17′	500	40	44	49	59	68	75	78	76	71	60	50	42	59	76	60	42	59	11
Charlotte—a and d	35°15′	80°51′	785	41	44	50	59	69	76	80	77	71	60	49	42	59	78	60	42	60	12
Coinjock—a	36°20′	75°52′	20	41	42	48	56	65	72	79	76	71	61	51	42	56	76	61	42	59	13
Davidson College—b	35°32′	80°51′	850	42	41	50	58	66	74	76	80	64	57	45	43	58	77	55	42	58	14
Edenton—a	36° 4′	76°41′	30	40	42	45	59	68	73	80	80	72	58	47	36	57	78	59	39	58	15
Elworth—d	35°30′	82°20′	2400	35	35	43	55	68	71	75	73	65	50	43	36	55	73	56	34	55	16
Fayetteville—a and b	35° 5′	78°53′	170	43	44	54	61	69	76	80	78	71	62	49	43	61	78	61	43	61	17
Flat Rock—d	35°30′	81°28′	.....	33	36	44	56	63	68	71	69	64	54	46	33	54	69	56	34	53	18
Forest Hill—a	35°16′	83° 4′	2500	38	39	45	55	61	72	74	70	62	53	43	39	54	72	53	39	55	19
Franklin—a and b	35°13′	83°15′	2141	38	40	44	53	63	68	71	70	64	53	44	37	53	70	54	38	54	20
(4) Gaston—c	36°28′	77°38′	152	37	42	48	54	66	74	78	76	68	58	47	40	56	76	58	40	57	21
Goldsboro—c	35°21′	78° 2′	167	42	48	51	61	69	77	81	79	73	62	51	44	60	79	62	45	62	22
Greensboro—a and b	36° 5′	79°50′	843	41	44	50	58	69	76	79	76	71	61	48	41	59	77	60	42	59	23
Greenville—a	35°38′	77°22′	35	44	46	53	59	67	76	79	77	72	62	51	43	60	77	62	44	61	24
Hanging Dog—d	35°11′	80° 43′	.....	...	43	39	54	70	...	...	...	...	...	...	...	29	54	...	...	...	...	25
Hatteras, Cape—c & d	35°14′	75°30′	20	45	46	50	56	65	74	79	78	74	65	56	47	57	77	65	46	61	26
Henry—a	35°16′	82°14′	.....	34	38	42	55	66	71	72	71	65	57	43	35	54	71	55	36	54	27
Highlands—a	35° 5′	83°25′	4000	35	35	43	50	57	65	68	65	59	51	41	33	50	66	50	34	50	28
Hot Springs—d	36°10′	83°10′	1330	...	...	...	...	...	71	76	73	69	55	48	40	...	73	57	...	...	29

Fahrenheit) at Stations in North Carolina. (Computed from the of Observations).

case by the letter or letters accompanying the name: a MS. records of the N. C. Geo- 1876, and MS. records; d Annual Reports and MS. records of the U. S. Signal Service; Agricultural Experiment Station.

	SERIES. Begins.		Ends.		EXTENT. Yrs.	Mos.	Observers.
1					4	0	U. S. Agricultural Department.
2	Aug.,	1857	Mar.,	1880	11	3	{Drs. J. F. E. and J. G. Hardy. {Dr. W. Gleitsman.
3	April,	1861	Dec.,	1873	7	7	F. J. Kron.
4	Oct.,	1871	May,	1876	1	9	J. H. Green.
5	Dec.,	1875	July,	1877	0	11	J. S. Hill and E. H. Banner.
6	Feb.,	1872	Dec.,	1872	0	11	J. Rumley.
7					3	1	W. B. Council.
8	Jan.,	1884	Mar.,	1885	1	3	United States Signal Service.
9	June,	1880	Dec.,	1882	2	7	Hugh Leach.
10	Dec.,	1881	Jan.,	1883	1	2	Dr. H. P. Satchell.
11	Jan.,	1820	Dec.,	1886	33	0	Jos. Caldwell, Jas. Phillips, etc.
12	Sept.,	1871	Dec.,	1883	8	0	G. B. Hanna and U. S. Signal Observer.
13	Jan.,	1875	Dec.,	1881	6	2	H. B. Ansell.
14	Nov.,	1857	Dec.,	1859	2	0	W. C. Kerr.
15	Jan.,	1872	July,	1873	1	7	R. W. and M. A. Hines.
16	April,	1880	Nov.,	1881	1	8	J. M. Worth.
17	Mar.,	1871	Dec.,	1882	6	0	J. M. Worth and others.
18	Aug.,	1884	June,	1887	1	9	E. R. Memminger.
19	April,	1872	Feb.,	1880	4	8	Mrs. D. D. Davis and Hattie E. Long.
20	Mar.,	1872	Dec.,	1882	8	7	Albert and Mrs. Siler.
21	Oct.,	1856	Mar.,	1861	4	6	Dr. G. F. Moore.
22	Jan.,	1856	Dec.,	1873	7	0	D. Morrille, etc.
23					10	9	S. A. Howard, etc.
24	Mar.,	1875	Nov.,	1881	6	9	Dr. C. J. O'Hagan, etc.
25	Dec.,	1886	May,	1887	0	5	D. W. Dewcese.
26	Oct.,	1874	Dec.,	1883	7	6	G. Onslow, etc.
27	April,	1880	Nov.,	1881	1	8	J. M. Worth.
28	Jan.,	1877	Dec.,	1882	5	6	Baxter White, etc.
29	June,	1887	Dec.,	1887	0	7	

Station.	Lat.	Long.	Height.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Annual.	
Jackson	36°20′	77°25′	.....	41	47	53	58	70	76	79	...	...	61	49	26	60	...	...	38	...	30
Kelly's	34°29′	78°23′	.....	...	47	52	61	69	76	80	80	71	64	45	42	61	79	60	...	...	31
Kenansville—c	34°58′	77°58′	60	46	43	49	57	67	75	79	78	69	57	47	40	58	77	58	43	59	32
Kinston—a	35°16′	77°33′	45	41	47	51	58	70	76	80	79	74	63	50	43	60	78	62	44	61	33
Kitty Hawk—d	36° 4′	75°33′	22	43	44	48	54	64	73	79	77	73	64	53	45	55	76	63	44	59	34
Leaksville—a	36°30′	79°47′	496	34	40	50	58	61	70	78	75	68	57	45	37	56	74	57	37	56	35
Lenoir—a and b	35°57′	81°34′	1185	37	41	47	56	65	71	76	73	67	56	44	38	56	73	56	[illegible]	[illegible]	36
Lincolnton—d	35°29′	81°12′	8718	33	38	43	55	66	72	76	74	68	55	43	37	55	74	56	36	55	37
Lookout, Cape—c	34°36′	76°36′	15	48	48	54	60	68	75	81	80	75	65	56	45	61	79	65	49	63	38
Lumberton—d	34°38′	79° 0′	.....	..	...	...	61	72	75	80	78	71	63	...	...	...	78	...	...	...	39
Macon, Fort—c and a	34°41′	76°40′	20	45	46	50	58	68	76	79	79	75	66	56	48	59	78	66	46	62	40
Manly	35°13′	79°22′	.....	43	51	51	61	67	78	78	76	72	64	48	48	60	77	61	47	61	41
Marlborough—c	35°28′	77°36′	.....	48	41	50	62	68	77	...	79	...	...	...	...	60	...	...	...	...	42
Monroe—c	34°55′	80°35′	575	42	...	50	62	...	...	81	75	69	58	50	43	...	...	59	...	...	43
Mount Airy—c	36°30′	80°38′	1048	32	38	41	56	67	71	76	76	...	...	...	37	55	74	...	36	...	44
Mount Olive—c	35°14′	77°55′	156	...	...	...	...	...	...	...	81	80	69	56	...	...	...	...	...	...	45
Mt. Pleasant—d and c	35°22′	80°27′	590	41	44	48	57	69	76	77	74	69	57	48	43	58	78	58	43	59	46
Morganton—c and a	35°45′	81°55′	1184	38	38	50	58	68	73	80	...	...	...	46	51	59	...	...	42	...	47
Murfreesboro—c	36°26′	77° 1′	75	41	45	49	57	66	76	77	76	69	58	49	43	57	76	59	43	59	48
Murphy—a	35° 6′	83°29′	1614	40	41	47	56	64	70	74	72	66	54	45	38	56	72	55	40	56	49
Newbern—a	35° 6′	77° 2′	12	45	47	52	59	68	75	79	77	73	62	52	45	60	77	62	46	61	50
New Garden—c	36° 0′	79°55′	860	36	40	44	59	66	73	78	76	71	56	42	32	56	76	56	36	56	51
*(5) Oaks—a	36° 0′	79° 0′	.....	39	35	42	50	59	66	72	72	65	49	48	43	50	70	54	39	53	52
(6) Ogreeta—d	35° 0′	84° 0′	1520	29	45	41	...	...	...	70	...	...	...	...	36	...	...	...	37	...	53
Ore Knob—d	36°30′	81°28′	4800	29	38	37	...	...	71	74	73	...	...	...	30	...	73	..	32	...	54
Oxford—c	36°19′	78°41′	475	38	42	46	58	66	75	79	76	68	56	45	38	57	77	56	39	57	55
Poplar Branch—b	36°14′	75°52′	10	43	44	45	57	68	75	81	80	75	60	49	43	57	79	61	43	60	56
Portsmouth—d	35° 2′	76° 4′	10	46	49	54	59	68	74	80	78	77	69	56	48	60	77	67	48	63	57
Raleigh—a and c	35°47′	78°41′	365	40	45	50	59	68	76	81	78	72	62	50	42	59	78	61	42	60	58
Reidsville—d	36°30′	79°40′	1000	31	36	46	54	66	64	75	75	75	55	41	41	56	72	57	36	55	59
(7) Roan Mountain—a	36° 7′	82°11′	6306	...	...	...	..	...	55	59	57	53	...	...	...	...	57	...	...	...	60
†Rutherfordton—a & c	35°24′	81°48′	800	35	42	54	61	...	77	77	76	68	59	51	41	...	77	59	39	...	61
Salem—c	36°51′	80°15′	1000	35	46	45	56	69	73	...	...	...	...	...	40	57	...	...	40	...	62
Salisbury—d	35°44′	80°29′	760	44	45	...	60	66	74	77	76	68	57	...	...	...	75	...	...	...	63

	SERIES. Begins.	Ends.	EXTENT. Yrs.	Mos.	Observers.
30	1852.....	1854	2.....	0	G. Wald, etc.
31	Mar., 1882	Mar., 1883	1.....	1	J. M. Worth.
32	Jan., 1860.....	May, 1870	3.....	0	N. B. Webster and J. M. Sprunt.
33	Sept., 1880.....	May, 1882	1.....	9	R. H. Lewis.
34	Feb., 1875.....	Dec., 1883	8.....	11	United States Signal Service.
35	Jan., 1873.....	Feb., 1879	2.....	2	G. W. Peay.
36	Aug., 1871.....	Dec., 1882	10.....	9	R. L. Beall.
37	June, 1884.....	Dec., 1887	3.....	7	Dr. L. R. Standemayer.
38	May, 1876.....	Dec., 1880	4.....	8	United States Signal Observer.
39	April, 1883.....	Oct., 1887	5.....	0	
40	Oct., 1833.....	Dec., 1883	11.....	0	Assist. Surgeon and U. S. Sig. Observer.
41	Dec., 1881.....	Dec., 1883	1.....	3	G. H. Saddleson.
42	Jan., 1858.....	Aug., 1858	0.....	7	
43	Jan., 1887.....	Dec., 1887	0.....	9	D. C. Anderson.
44	Aug., 1871.....	Aug., 1872	0.....	10	Robert S. Gilmer.
45	July, 1869.....	Oct., 1869	0.....	4	E. D. Pearsall.
46	April, 1874.....	Dec., 1887	2.....	3	H. T. J. Ludwig.
47	Dec., 1867..... 1876.....	July, 1868 1880	1.....	3	Nelson Falls and E. B. Claywell.
48	Oct., 1856.....	April, 1861	4.....	3	N. and A. McDowell.
49	Mar., 1872	Dec., 1882	10.....	4	William Beall.
50	Feb., 1872.....	Dec., 1882	10.....	0	R. Berry and C. Duffy.
51	July, 1872.	Nov., 1873	1.....	5	A. E. Kitchen.
52	Jan., 1850.....	Dec., 1850	1.....	0	William Bingham.
53	Feb., 1883.....	July, 1884	0.....	6	G. G. Whitcomb.
54	Dec., 1882.....	Aug., 1883	0.....	7	Frank Walter.
55	July, 1866.....	Dec., 1873	7.....	6	J. H. Mills and Dr. W. R. Hicks.
56	.....		2.....	3	J. M. Woodhouse.
57	July, 1877.....	June, 1883	4.....	0	United States Signal Observer.
58	Aug., 1866.....	Dec., 1886	15.....	7	F. P. Brewer, T. C. Harris and others.
59	Aug., 1885.	Sept., 1887	2.....	1	F. J. Norcom.
60	June, 1879.....	Aug., 1880	0.....	4	L. L. Searle and Mrs. W. B. Phillips.
61	June, 1849..... July, 1872.....	Dec., 1849 April, 1878	0..... 1.....	7 2	Galloway.† Miss Dickerson, etc.
62	Jan., 1887.....	Dec., 1887	0.....	7	Rev. John Clewell.
63	Jan., 1874.....	Oct., 1887	2.....	7	H. F. J. Sudwick.

Station.	Lat.	Long.	Height.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Annual.	
Scotland Neck—a	36° 7′	77°32′	50	41	43	49	55	66	74	78	75	70	60	48	41	57	76	59	42	58	64
‡Scuppernong—c	35°50′	76°18′	25	41	45	51	55	68	73	78	74	69	61	51	46	58	75	60	44	59	65
(8) Smithville—c and d	33°55′	78° 1′	20	48	50	56	63	72	79	82	80	76	67	57	50	64	80	67	49	65	66
Stag's Creek—b	36°26′	81°33′	3000	34	34	42	49	60	70	72	67	63	46	41	36	50	70	50	35	51	67
Statesville (near)—d	35°47′	80°54′	940	38	41	47	57	66	73	77	75	67	51	40	36	56	75	53	38	56	68
Sugar Grove—a	36°16′	81°47′	.....	32	31	46	55	60	65	74	71	65	54	43	30	54	70	54	31	52	69
Tarboro—a and c	35°52′	77°40′	50	39	42	42	58	68	73	79	77	71	58	46	37	56	76	58	39	57	70
Thornburg—c	36°20′	77°21′	.....	41	40	49	59	70	75	80	78	74	60	47	38	59	78	60	40	59	71
Trinity College—c	35°45′	79°40′	400	40	44	47	57	64	...	...	...	...	...	...	...	56	...	...	...	...	72
Wadesboro—d	34°58′	80°05′	445	..	...	...	62	70	75	80	77	71	64	...	...	...	77	...	...	...	73
Wake Forest Col.—d	36° 0′	78°30′	409	51	59	60	70	80	...	90	84	82	66	58	49	70	...	68	53	...	74
Warrenton—c	36°24′	78°16′	451	42	39	42	55	65	74	78	75	68	60	49	38	54	76	59	40	57	75
†Waynesville—a	35°29′	82°58′	2756	39	41	44	53	59	67	70	67	...	52	44	45	52	68	..	42	...	76
Weldon—a and d	36°24′	77°30′	81	41	43	48	57	68	76	80	76	71	59	48	40	58	78	59	41	59	77
‡Westminster—c	36°02′	79°52′	.....	...	...	...	...	...	74	78	74	...	...	...	...	...	75	...	...	...	78
White Sul. Springs—d	35°30′	83° 0′	2716	41	37	58	54	61	66	70	68	...	53	46	37	58	66	...	39	...	79
Wilmington—c and d	34°17′	77°58′	50	47	49	55	62	70	77	81	79	73	64	54	48	62	79	64	48	63	80
Wilson—c	35°45′	77°47′	105	41	44	51	64	67	77	81	75	74	60	51	42	61	78	62	42	61	81
Coast Division of the State				44	46	50	58	68	74	80	78	74	63	53	45	59	77	63	45	61	82
Sub-Eastern Division of the State				42	44	50	58	67	75	79	77	71	60	49	42	58	77	60	43	59	83
Middle Division of the State				39	42	48	57	66	74	79	76	69	59	47	39	57	76	58	40	58	84
Piedmont Division of the State				35	39	47	57	66	73	77	75	68	57	46	41	57	75	57	38	57	85
Western Division of the State				36	37	43	52	60	68	72	69	63	52	42	36	52	70	52	36	52	86

(1) Eight miles east of Albemarle.
(2) Station was located four miles east of Carthage.
(3) Station near Webster, Jackson county.
(4) Green Plains.
(5) Formerly Bethmout.
(6) Cherokee county.

	SERIES. Begins.	Ends.	EXTENT. Yrs.	Mos.	Observers.
64	Dec., 1872	Dec., 1882	9	10	James N. Smith.
65	Jan., 1849	Sept., 1853	3	0	Shepherd and Hardison.†
66	Jan., 1822	Dec., 1883	27	11	Ass't. U. S. Surg'n and U. S. Sig. Observ'r.
67	.....	.....	2	1	Dr. J. A. Allison.
68	June, 1866	Dec., 1887	18	6	Sue Herman.
69	Mar., 1878	Mar., 1879	1	1	R. H. and R. W. and Th. Norfleet.
70	Aug., 1871	Jan., 1873	1	7	Rev. T. Fitzgerald and Prof. D. Morrelle.
71	Jan., 1854	April, 1855	1	4	O. W. Carr and others.
72	Jan., 1861	May, 1869	0	5	
73	April, 1883	Oct., 1887	2	6	W. G. Simmons.
74	Oct., 1885	July, 1887	1	4	Dr. W. Johnston and H. A. Foote.
75	Aug., 1857	Dec., 1870	1	4	
76	.....	.....	2	9	T. A. Clark.
77	Feb., 1872	Dec., 1887	14	10	
78	1843		0	3	J. Watkins.
79	Feb., 1879	Dec., 1886	2	3	W. W. Stringfield.
80	Jan., 1872	Dec., 1883	12	0	D. Morrelle and U. S. Signal Observers.
81	1866		1	0	E. W. Adams.

82	Average elevation	15	feet, area(9)	9500	square miles.
83	"	150	" "	12000	"
84	"	650	" "	14000	"
85	"	1200	" "	7500	"
86	"	2700	" "	5700	"

(7) At Cloudland Hotel.
(8) Formerly Fort Johnston. The name has recently been changed to Southport.
(9) These areas are approximate, and do not include the water surfaces.
*Observations taken at sunrise.
†Observations taken at sunrise, 9 A. M., 3 and 9 P. M.
‡Observations taken at sunrise, noon and sunset.

Mean amount of Precipitation in Rain and Melted Snow for each Month, Season, and Year, at the several Stations in North Carolina where Observations have been made. (Computed from the Commencement of Observations).

[Records of Stations are to be credited to the following sources: **a** N. C. Geological Survey, MS. records; **b** Kerr's Geology of N. C., 1875; **c** Smithsonian Contributions to Knowledge, Vol. XXIV, 1885 (Precipitation Tables 1881), and MS. records; **d** Annual Reports and MS. records of the U. S. Signal Service; **e** MS. records of the N. C. Agricultural Experiment Station. For elevation, latitude and longitude of stations and observers see temperature tables, pages 33—37.]

Station.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.	Extent. Yrs.	Extent. Mos.	Series. Began.	Series. Ended.
Albemarle—b	4.9	3.7	6.4	4.6	4.6	4.8	3.8	5.8	3.9	4.9	2.9	4.9	15.6	14.4	11.0	13.5	54.5	4	0		
Asheville—a and c	2.6	3.7	3.8	3.5	3.6	4.0	4.8	4.2	2.2	2.4	2.7	3.0	10.9	13.0	7.3	9.3	40.5	11	1	Feb., 1869	Mar., 1880
Attaway Hill—c	4.2	5.0	5.2	4.6	5.4	4.4	5.9	5.1	5.0	3.8	2.9	3.7	15.3	13.4	11.7	12.8	53.2	8	7	April, 1861	Dec., 1874
Bakersville—a	1.8	0.5	2.3	1.7	.....	1.5	2.6	4.0	3.2	1.7	1.7	1.8	.....	8.1	6.6	4.1	.....	1	2	Oct., 1871	May, 1876
Banner's Elk—a	3.2	4.7	15.5	19.7	7.0	8.9	4.7	.....	.....	.....	.....	5.4	42.2	.....	.....	13.3	.....	0	11	Dec., 1875	July, 1877
Beaufort—a	4.6	14.5	10.5	4.9	3.8	2.8	1.7	3.6	2.1	4.6	4.0	3.2	19.2	8.1	10.7	22.3	60.3	11	11	.....	.....
Boone—a	9.9	6.1	6.4	9.4	4.3	4.9	3.5	2.3	4.2	1.1	0.8	0.0	20.1	10.7	6.1	16.0	52.9	3	1	.....	.....
Brevard—d	9.8	7.7	8.4	5.0	2.2	12.9	0.1	1.7	2.7	1.3	4.3	7.6	15.6	14.7	8.3	25.1	63.7	1	8	July, 1883	Mar., 1885
Carthage—a	4.4	4.8	3.5	4.4	2.3	4.3	4.2	6.4	2.5	3.4	4.6	4.3	10.2	14.9	10.5	13.5	49.1	2	7	June, 1880	Dec., 1882
Chapel Hill—a and c	3.7	3.4	4.2	3.7	3.8	3.0	4.9	4.1	3.4	3.1	3.2	3.9	11.7	12.0	9.7	11.0	44.4	13	10	June, 1856	Dec., 1885
Charlotte—d	6.5	4.6	5.3	5.5	3.3	4.1	5.8	4.6	3.3	3.7	4.1	5.2	14.1	14.5	11.1	16.3	56.0	7	3	Oct., 1878	Dec., 1885
Coinjock—a	2.5	2.3	4.5	4.4	2.0	3.4	6.3	7.3	6.0	5.2	3.0	3.0	10.9	17.0	14.2	7.8	49.9	6	2	Jan., 1875	Dec., 1881
Davidson College—d	4.9	3.9	4.8	3.8	3.3	3.6	3.1	3.4	1.2	4.1	4.6	3.4	11.9	10.1	9.9	12.2	44.1	2	0	Nov., 1857	Dec., 1859
Edenton—a	4.6	5.8	5.2	2.1	6.9	2.2	5.4	3.1	2.5	6.3	1.9	3.3	14.2	10.7	10.7	13.7	49.3	1	7	Jan., 1872	July, 1873
Elsworth—d	8.3	1.5	7.9	9.5	7.3	4.6	9.1	5.2	2.1	6.1	4.9	1.5	24.6	18.9	13.1	11.3	68.0	1	8	April, 1880	Nov., 1881

Fayetteville—a	6.3	5.0	4.1	7.3	4.0	2.6	11.3	6.1	6.4	4.4	4.5	8.0	15.4	20.0	15.3	19.3	70.0	3	0	Nov.,	1871	Dec.,	1882
Flat Rock—d	3.9	1.2	8.6	4.5	7.5	5.1	2.8	3.7	3.5	4.5	4.5	5.2	20.7	11.6	12.6	10.2	55.1	1	9	Aug.,	1884	June,	1887
Forest Hill—a	2.9	5.0	3.6	3.9	2.5	1.2	2.6	2.8	1.5	3.4	2.1	2.7	10.0	6.6	7.0	10.6	34.2	4	6	April,	1872	Feb.,	1880
(1) Fort Johnston—d	3.4	3.3	4.5	1.8	4.8	3.5	5.3	5.8	7.7	4.1	2.8	3.6	11.1	14.6	14.6	10.1	50.4	7	11	Jan.,	1844	Mar.,	1877
Franklin—a	6.4	7.0	7.7	4.6	3.6	4.8	6.0	6.4	4.0	4.4	3.7	5.0	15.9	17.2	12.1	18.4	63.6	8	8	Mar.,	1872	Dec.,	1882
Gaston—c	3.0	2.7	3.2	4.2	4.7	2.6	4.4	4.8	3.4	2.5	3.1	4.6	12.1	11.8	9.0	10.3	43.2	4	8	Aug.,	1856	Mar.,	1861
Goldsboro—c	3.0	3.7	4.1	4.5	5.5	5.6	6.5	7.2	3.9	4.1	2.9	3.4	14.1	19.3	11.0	10.1	54.5	6	11	Mar.,	1869	Dec.,	1874
Greensboro—a and b	1.7	1.5	2.0	1.7	1.6	1.7	2.0	2.1	1.8	1.0	1.6	1.8	5.3	5.8	4.4	5.0	20.5	11	2	Aug.,	1871		
Greenville—a	3.6	2.9	5.4	4.2	2.7	4.1	5.4	8.4	7.1	3.1	2.7	6.2	12.3	17.9	12.9	12.7	55.8	6	9	Mar.,	1875	Nov.,	1881
Hatteras—d	6.6	5.2	7.5	5.5	4.2	4.7	6.2	6.2	7.3	7.0	6.1	6.4	17.2	17.1	20.4	18.2	72.9	11	4	Sept.,	1874	Dec.,	1885
Henry's—a	8.7	14.7	7.9	9.5	7.3	4.6	8.9	17.9	21.0	7.6	11.0	13.0	24.7	31.4	39.6	36.4	132.1	1	8	April,	1880	Nov.,	1881
Highlands—a	6.7	8.5	6.3	6.1	5.2	3.2	5.8	5.2	10.7	7.5	8.0	8.0	17.6	14.2	26.2	23.2	81.2	3	6	Jan.,	1879	Dec.,	1882
Jackson—c	2.5	2.2	3.4	2.8	2.0	1.7	2.8	.....	.....	.....	2.4	2.1	8.2	.....	.....	6.8	.....	1	1	Jan.,	1854	April,	1855
Kelly's—a	.....	3.3	9.6	13.6	3.1	6.6	10.5	10.7	6.3	5.7	2.3	8.5	26.3	27.8	14.3	.....	.....	1	2	Feb.,	1882	Mar.,	1883
Kenansville—c	6.5	4.6	2.7	7.8	5.1	7.4	9.5	2.7	1.4	11.2	2.0	6.5	15.6	19.6	14.6	17.6	67.4	1	3	Mar.,	1868	May,	1869
Kinston—a	3.9	1.7	4.1	4.2	3.2	3.7	3.1	2.6	1.4	2.6	3.1	2.1	11.5	9.4	7.1	7.7	35.7	1	9	Sept.,	1880	May,	1882
Kitty Hawk—d	6.1	4.0	6.0	5.6	3.3	4.6	6.6	7.5	6.0	4.4	5.2	5.4	14.9	18.7	15.6	15.5	64.7	11	0	Jan.,	1875	Dec.,	1885
Leaksville—a	5.2	2.1	0.5	3.8	2.1	3.5	2.2	2.3	3.5	4.5	6.8	4.3	6.4	8.0	14.8	11.6	40.8	2	2	Jan.,	1873	Feb.,	1879
Lenoir—a	4.2	4.7	4.5	3.9	3.1	3.6	4.5	6.4	5.1	3.1	4.0	5.0	11.5	14.5	12.2	13.9	52.1	10	9	Nov.,	1871	Dec.,	1882
Lincolnton—d	3.7	7.3	4.1	2.9	8.1	4.0	5.0	5.4	2.0	3.2	3.4	5.0	15.1	14.4	8.6	16.1	54.1	3	6	June,	1884	Dec.,	1887
Lookout, Cape—d	6.1	4.5	4.5	5.6	5.1	5.5	5.2	10.3	9.1	6.7	6.1	6.1	15.2	21.0	22.9	16.7	75.8	4	8	May,	1876	Dec.,	1880
Lumberton—d	.....	.....	.....	2.9	4.0	6.0	4.9	5.6	5.8	4.1	.....	.....	.....	16.4	.....	.....	.....	0	31	April,	1883	Oct.,	1887
Macon, Fort—d	6.0	3.1	5.4	3.9	4.1	5.5	6.4	6.5	7.2	3.7	3.0	4.7	13.4	18.4	13.9	13.8	59.5	7	7	June,	1878	Dec.,	1885

Station.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Spring.	Summer.	Autumn.	Winter.	Year.	Extent. Yrs.	Mos.	Series. Began.	Ended.
Manly—a	5.7	4.6	5.4	4.9	3.5	2.0	3.2	9.3	3.7	4.0	2.4	.....	13.8	14.5	10.1	.....	.....	1	3	Dec., 1881	April, 1883
Marlborough—c	3.8	5.8	2.9	5.2	2.8	3.9	5.3	4.0	.....	.....	.....	.....	10.8	13.2	.....	.....	.....	0	7	Jan., 1858	Aug., 1858
Monroe—c	3.4	.....	7.6	2.5	.....	.....	5.8	9.4	1.7	6.4	0.5	4.2	.....	.....	8.7	.....	.....	0	9	Jan., 1887	Dec., 1887
Mount Airy—a	2.0	3.1	3.5	0.2	.....	4.7	3.1	6.0	.....	.....	.....	2.5	.....	13.8	.....	7.6	.....	0	7	Dec., 1871	Aug., 1872
(2) Mount Holly—d	3.1	2.5	3.3	2.6	6.6	5.1	6.7	1.8	00.0	4.4	2.8	3.6	12.6	13.7	7.2	9.2	42.3	1	11	Sept., 1885	Dec., 1887
Mount Olive—c	.....	.....	.....	.....	.....	.....	10.4	7.2	5.1	2.5	.....	.....	.....	.....	.....	.....	.....	0	4	July, 1869	Oct., 1869
Mount Pleasant—d	2.5	4.2	7.3	3.0	3.5	4.7	6.4	7.3	3.8	5.1	1.0	3.5	13.8	18.5	10.0	10.2	52.4	2	3	April, 1874	Dec., 1877
Murfreesboro—c	2.9	3.4	2.8	4.0	3.7	2.8	4.3	3.1	2.8	2.0	2.8	3.0	10.5	10.2	7.6	9.3	37.6	5	1	Oct., 1856	Oct., 1861
Murphy—a	5.9	7.5	6.8	6.2	3.4	5.1	6.3	6.2	3.2	3.2	4.4	7.4	16.4	17.6	10.8	20.8	65.6	10	4	Mar., 1872	Dec., 1882
Newbern—a	4.2	4.1	4.6	4.3	4.9	5.4	8.0	9.2	6.6	4.4	3.8	4.1	13.8	22.6	14.8	12.4	63.6	9	11	Feb., 1872	Dec., 1882
New Garden—c	4.3	6.3	2.4	4.8	5.5	4.5	3.5	6.5	4.4	2.3	3.0	2.7	12.7	14.5	9.7	13.3	50.2	2	0	Dec., 1872	Dec., 1874
(3) New River Inlet—d	6.5	3.1	3.2	2.7	2.7	4.5	6.8	8.7	5.9	3.6	2.5	3.7	8.6	20.0	12.0	13.3	63.9	4	1	Aug., 1882	Dec., 1886
Oxford—c	3.6	4.7	3.8	3.3	5.7	3.3	4.5	4.6	4.0	3.0	3.0	2.5	12.7	12.5	10.0	10.8	46.0	7	5	Jan., 1867	Oct., 1874
Poplar Branch—a	3.9	5.3	3.7	5.9	5.1	3.8	4.0	5.3	3.2	4.5	2.8	2.3	14.7	13.1	10.5	11.5	49.8	2	4	.....	.....
Portsmouth—d	6.4	3.9	5.9	3.8	4.0	5.7	6.1	8.2	7.1	5.7	4.3	5.9	13.7	20.0	17.1	16.2	67.0	4	10	July, 1877	June, 1883
Raleigh—a and c	3.6	3.2	3.5	3.4	3.5	3.2	3.6	6.0	3.4	2.4	2.7	3.6	10.4	12.8	8.5	10.4	42.1	11	5	Jan., 1872	Dec., 1886
Reidsville—d	1.8	0.2	1.5	2.4	4.9	5.8	4.4	5.7	1.5	1.7	4.8	1.0	8.8	15.9	8.1	3.0	35.8	1	11	Oct., 1885	Sept., 1887
Rutherfordton—a and c	4.8	5.8	1.5	3.5	.....	.....	3.8	4.0	4.7	3.8	5.6	4.6	14.1	.....	.....	15.2	....	1	2	July, 1872	April, 1878
Salem—e	2.3	3.7	3.7	2.9	5.1	3.7	.....	.....	.....	.....	.....	4.7	11.7	.....	.....	10.7	.....	0	7	Jan., 1887	Dec., 1887
Salisbury—d	4.5	3.4	.....	3.4	6.3	7.2	4.3	5.6	2.2	6.9	.....	.....	.....	17.1	.....	.....	.....	0	29	May, 1883	Oct., 1887

Salisbury—d	4.5	3.4	.....	3.4	6.3	7.2	4.3	5.6	2.2	6.9	.....	.....	.....	17.1	.....	.....	.....	0	29	May,	1883	Oct.,	1887
Scotland Neck—a	3.8	3.4	4.2	4.4	3.5	2.7	4.8	7.7	5.6	2.2	3.6	4.9	12.1	15.2	11.4	12.1	59.8	9	10	Dec.,	1872	Dec.,	1882
Scott's Hill—d	7.7	3.3	3.9	2.4	4.7	7.4	7.3	4.5	11.5	2.8	2.1	2.5	11.1	19.3	16.5	13.5	60.3	2	4	Oct.,	1882	May,	1885
(4) Smithville—d	4.0	2.9	4.0	3.3	3.0	3.3	5.9	5.5	6.5	5.4	3.1	3.5	10.3	14.7	15.0	10.4	50.4	10	2	Nov.,	1875	Dec.,	1885
Stag's Creek	5.1	6.6	4.4	4.3	5.6	4.4	3.7	4.5	3.5	1.5	2.5	3.0	14.3	12.6	7.5	14.7	49.1	2	0				
(5) Statesville—d	4.0	4.6	5.6	3.6	3.9	4.2	4.1	5.0	3.5	3.4	3.2	4.2	13.1	13.4	10.2	12.8	49.5	16	9	June,	1866	Dec.,	1887
Sugar Grove—a	7.5	4.9	8.3	4.5	8.8	3.5	3.4	8.1	7.5	4.1	4.8	5.3	21.6	15.0	16.4	17.7	70.7	1	1	Mar.,	1878	Mar.,	1879
Tarboro—a and c	2.9	4.6	6.4	2.6	6.6	4.9	5.0	6.0	4.3	10.5	3.1	3.0	15.6	15.9	17.9	10.5	59.9	1	4	Nov.,	1871	Feb.,	1873
Trinity College—c	3.7	13.0	2.7	2.0	7.0	.....	.....	.....	.....	.....	.....	.....	11.7	.....	.....	.....	.....	0	5	Jan.,	1861	May,	1869
Wadesboro—d	.....	.....	.....	1.1	2.9	3.1	4.8	3.4	2.4	3.6	.....	.....	.....	.....	11.3	.....	.....	0	30	April,	1883	Oct.,	1887
Wake Forest College—d	.....	4.4	4.3	2.6	3.2	.....	8.3	2.7	4.8	3.0	2.1	3.6	10.1	9.9	....	.....	.....	0	15	Oct.,	1885	July,	1887
(6) Wash Woods—d	4.6	4.0	3.7	2.5	3.8	4.7	3.9	3.2	2.2	2.7	1.3	3.0	10.1	11.8	6.3	11.6	39.7	5	1	May,	1882	Dec.,	1887
Warrenton—c	2.4	4.1	3.4	2.2	4.3	2.5	5.4	3.8	2.7	2.3	1.7	2.6	10.0	11.7	6.7	9.1	37.5	1	7	April,	1857	Dec.,	1870
Waynesville—a	7.2	3.0	5.0	5.0	4.6	2.2	4.2	6.0	4.1	.....	0.6	3.6	14.6	12.4	.....	13.8	.....	0	0				
Weldon—a and d	3.7	3.1	3.7	3.3	3.9	3.5	4.8	5.4	3.6	3.6	2.4	3.4	10.8	13.8	9.7	10.2	45.5	15	9	Feb.,	1872	Dec.,	1887
White Sulphur Springs—d	6.7	2.5	4.4	3.7	1.7	2.0	5.0	5.1	.....	.....	0.1	3.3	9.9	12.1	.....	12.5	.....	0	17	Feb.,	1879	Dec.,	1886
Wilmington—d	4.0	3.4	4.3	3.3	4.4	6.2	6.2	7.9	7.6	4.1	2.7	3.6	12.0	20.3	14.4	11.0	57.7	15	0	Jan.,	1871	Dec.,	1885
Wilson—c	.....	2.4	1.1	6.3	1.8	4.9	6.6	3.3	4.9	2.9	2.4	2.2	9.2	14.8	10.2	.....	.....	0	11	Feb.,	1866	Dec.,	1886
Coast Region	4.4	5.1	5.6	4.7	3.9	4.0	5.8	6.6	5.8	5.5	3.9	4.4	14.2	16.4	15.2	13.9	59.7						
Sub-Eastern Region	4.3	3.8	4.3	4.9	4.4	4.7	6.8	5.6	4.6	5.4	3.0	5.0	13.6	17.1	13.0	13.1	56.8						
Middle Region	3.8	4.0	3.3	3.5	3.6	3.0	3.8	4.7	3.3	3.0	3.4	3.7	10.4	11.5	9.7	11.5	43.1						
Piedmont Region	3.7	5.2	3.4	2.6	5.6	4.1	4.1	5.4	3.9	3.4	4.3	4.3	11.6	13.6	11.6	13.2	50.0						
Western Region	5.6	5.3	5.5	4.9	4.6	3.5	4.3	5.0	4.4	3.3	3.1	4.0	15.0	12.8	10.8	14.9	53.5						
State	4.4	4.5	4.2	4.3	3.9	3.8	5.0	5.4	4.5	4.2	3.6	4.4	12.4	14.4	12.3	13.3	52.2						

For areas and elevation of the regions, see Temperature Tables, p. 37.

(1) Fort Johnston was located at Smithville (now South Port). (2) Lat. 35° 15′, Long. 81° 05′. (3) Lat. 34° 31′, Long. 77° 20′. (4) Now South Port.
(5) Station near Statesville. (6) Lat. 36° 30′, Long. 75° 50′.

REPORT OF RESIDENT VICE-PRESIDENT.

W. B. PHILLIPS.

The fifth year of the Society's existence, just passed, has been one of progress and prosperity. The number of meetings, the attendance upon them and the papers presented show gratifying interest and zeal for the Society's welfare. The Society can well claim to be doing a good work for the State and for the interests of Science in the South. Through its Journal it publishes to the world the work of its members, giving proof of valuable work done and affording much information about the State.

Eight Regular Meetings were held during the year and three Public Lectures delivered. These, with the Annual Meeting for Election of Officers, make twelve meetings for the year or fifty-two meetings in all since the foundation of the Society. The fifty-five papers presented during the past year bring up the total number to 278. A large proportion of these have been published in the Journal and many have appeared also in other scientific periodicals. These papers have steadily improved in value and importance. The eight monthly bulletins which have been issued have contained abstracts of these papers, as well as general outlines of the meetings.

The Librarian reports 1,391 books and pamphlets in the Society's library. Of these 124 are bound volumes. It would be well if the Society could bind its complete volumes of Journals, &c., but this is at present impossible. A pleasant room, conveniently arranged with shelving, desks and tables, has been set aside for the receipt and storage of the library.

The list of exchanges for our Journal is already a large one and is constantly increasing. It will be found at the end of this number. The additions to the library, through this and other channels, average one hundred per month.

The Society has lost by death two Honorary and two Regular Members:

Dr. H. W. Ravenel, Aiken, S. C.; elected Honorary Member 1886.

Dr. S. F. Baird, Washington, D. C.; elected Honorary Member 1887.

Dr. A. M. Shipp, Nashville, Tenn.; elected Regular Member 1883.

Dr. J. R. Duggan, Wake Forest, N. C.; elected Regular Member 1886.

REPORT OF RECORDING SECRETARY.

J. W. GORE.

BUSINESS MEETINGS.

MAY 19, 1887.

Dr. Phillips in the chair. The thanks of the Society were voted Hon. S. F. Phillips for his contribution to the Publishing Fund, and he was elected a Life Member.

Committees were appointed to report quarterly on the progress in the different branches of scientific work.

The Resident Vice-President and the Secretary were appointed a committee to arrange for Public Lectures, and also to make out the programme for the Regular Meetings.

DECEMBER 10, 1887.

Dr. Phillips in the chair. It was moved that the thanks of the Society be tendered Professor Poteat for his lecture on December 6th.

Furthermore, that it be considered the duty of those accepting the offices of President and Vice-President, in future, to meet with and address the Society at least once during their term of office.

The following resolutions were passed:

1st. That a list of all publications received be published in each issue of the Journal.

2d. That by payment of postage any member can have any book or pamphlet in the library mailed to his address. Postage must be pre-paid.

3d. The book or pamphlet must be returned at the close of two weeks, the member borrowing it paying for the return.

Information as to articles on special subjects appearing in Journals can generally be gotten by applying to the Secretary, enclosing a stamp for reply. Where abstracts of articles are desired, the services of an associate member can probably be secured.

It was further resolved that each member of the Council make a special contribution to the fitting up of the library room.

MAY 5, 1888.

Dr. Phillips in the chair. The following officers were elected for 1888–1889:

President—Professor W. J. Martin, Davidson College, N. C.

Vice-President—George B. Hanna, U. S. Mint, Charlotte, N. C.

Resident Vice-President—Professor R. H. Graves, Chapel Hill, N. C.

Treasurer—Dr. F. P. Venable, Chapel Hill, N. C.

Recording Secretary and Librarian—Professor J. W. Gore, Chapel Hill, N. C.

It was ordered that hereafter the Council pass upon all papers submitted for publication, and that the Permanent Secretary have charge of the publication of the Journal.

REPORT OF TREASURER.

F. P. VENABLE.

Fees for 1887	$100 00	
Fees for 1888	48 50	
Contributions	100 00	
Sales of Journals	23 15	
	$271 65	
Balance debit, 1886-'87		$ 7 95
Postage		13 40
Plates		6 15
Express		14 00
Printing		181 00
Stationery		6 15
		228 65
Balance credit May 5th, 1888		43 00
	$271 65	$271 65
Estimated expenses 1888-'89		$250 00

LIST OF PAPERS

READ AT THE

REGULAR MEETINGS, SPRING TERM, 1888.

XXXII Regular Meeting. January 11, 1888.

25. Statistics on Rain-fall in Relation to Forest-Growth, *J. W. Gore.*
26. Report on Progress in Chemistry..... *F. P. Venable.*
27. Professor Kerr's Observations on Old Glacier Valleys in North Carolina..... *J. A. Holmes.*
28. Professor Kerr on the Action of Frost on Superficial Layers of Soil..... *J. A. Holmes.*
29. Report on Mineralogy..... *W. B. Phillips.*
30. Abstract of Production of Minerals and Metals in the United States..... *W. B. Phillips.*
31. Study of Local Flora..... *Gerald McCarthy.*

Yale Studies in English